IRRIGATING WITH LIMITED WATER SUPPLIES

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Irrigation managers can do something other than purchase additional equipment or reduce irrigated acreage to accommodate limited water supplies, which appears to be an inevitability this year. Well-timed irrigations may help managers irrigate more acres without lowering crop yields.

By making the best use of water, irrigation managers can free up both water and equipment for use on other crops or other land. Seed-producing crops respond more to irrigations during one particular stage of development than during other stages. Some of those crops include corn, barley, sunflowers, wheat and beans. Yields of storage and forage crops—sugar beets, potatoes, alfalfa and grasses--are more directly related to climatic demand and cumulative water use during the season than to stress during any particular growth stage.

Sugar beets are quite drought tolerant. They can withstand extended periods without rainfall or irrigation water by using water stored in the soil. Limited water can even increase the efficiency of sucrose production. Sucrose yield per unit of water use can be increased above that where maximum water use is allowed, simply by cutting off irrigations three to four weeks before harvest operations. Sugar beets are only moderately sensitive to plant stress, except during the early growth stages. Afternoon leaf wilting during hot, dry, windy conditions has negligible effects on total sugar production. Water can be used more efficiently on sugar beets by applying one last major irrigation to recharge the entire soil profile at the onset of the major stress period. Sugar beets adapt to limited irrigations by using deeply stored soil water and quickly recovering, when water is made available following major stress periods. Normal irrigations of sugar beets could be reduced after the middle of July. Sucrose yield is likely to be reduced very little when such a practice is used and a final heavy irrigation is applied in early August.

Corn is very sensitive to drought stress, especially during the flowering and reproductive stages. Stress during the early vegetative stage is not nearly as serious as stress during flowering, pollination and early seed filling. Grain corn is most sensitive to drought stress between the 12-leaf and blister kernel stages; this period includes flowering, pollination and initial seed filling. Stress during any part of the cropping season limits grain corn production. To maximize water use efficiency in grain corn, it is best to limit irrigations during the vegetative stage. The period from emergence to 12-leaf was lease sensitive to stress.

Barley responds to drought stress much like corn and other cereal crops. Yield is likely to be reduced very little when drought stress occurs during the vegetative period. However, a major disadvantage of early drought stress is the tendency for plants to tiller more than usual. Although the increased tillering is desirable, often the tillers never produce grain-yielding heads. Barley is most sensitive to stress during jointing, booting and heading. Considering drought stress before, during and after heading, yield is reduced the most by drought before heading. Flowering and pollination appear to be the most sensitive periods.

Several studies have been conducted with spring wheat and winter wheat to evaluate the effect of limited irrigations on crop quality and production. Stress was most

critical during and after heading. This response is similar to that for barley. There is little or no measurable benefit from irrigating spring grains before the boot stage, unless moisture stress is evident. Stress is likely to occur when the plants appear wilted and the leaves curl. The period between grain filling and maturity is critical. Yield is reduced the most when stress starts during soft dough or during or following heading. Stress during the maturing process results in about a 10 percent lower yield. Moderate stress during the early vegetative period has essentially no effect on yield. Irrigation managers can use water most efficiently on spring-planted grains by reducing early-season irrigations and minimizing crop stress during flowering, pollination and seed filling. Drought stress on winter wheat production during early spring regrowth results in heading approximately seven to 10 days prematurely. The consequence of early heading is early maturity and a shortened growth period; thus, yield is reduced. Early stress results in development of more heads than usual. However, many of the heads fail to produce grain. Winter wheat is most sensitive to drought stress during shooting and booting. It is essential to avoid even slight water stress at jointing. Withholding water to increase tillering may lead to premature heading and grain maturity.

High-quality potato yields can be achieved only by maintaining a uniformly high level of available water throughout the crop season. Short four-to-five day stress periods do not lower yields significantly or deteriorate the quality of potatoes compared to unstressed crops. Potato production is directly related to crop water use between emergence and defoliation. Potatoes are not susceptible to severe yield reductions from short periods of moderate stress during any single period of production.

Alfalfa forage yield is directly related to available water and actual plant water use. Alfalfa is not nearly as sensitive to plant water stress at different times of the season as are most of the grain-producing crops. Forage increases of one-sixth to one-fifth ton per acre per year for each inch of applied water have been obtained. Maximum water use by alfalfa is not likely to exceed 24 inches between late April and the latter part of August. Most alfalfa varieties, when subjected to plant water stress, will go into dormancy, thus dramatically reducing both water use and production. When irrigation reduces stress, the crop resumes growth. Alfalfa is much less sensitive to plant water stress, regardless of when it occurs during the growing season.

Essentially two types of response occur when irrigated crops are subjected to drought stress. Determinate crops, which are grown primarily for the harvest of mature seed and depend on day length and season length, are most sensitive to drought stress during the seed formation period. This period includes heading, flowering and pollination. Crops most affected by stress during this period include small grains, other cereal crops and oilseed crops. Drought stress that occurs between seed development and maturity also limits yield, but to a lesser degree. These same crops are relatively insensitive to drought stress during the early vegetative period.

Indeterminate crops, such as tuber and root crops that are grown primarily for the harvest of storage organisms, are relatively insensitive to moderate drought stress for short intervals throughout the entire crop growing season. Crops like potatoes, sugar beets, alfalfa and pasture, quickly recover from short stress periods and little reduction in yield occurs.

Irrigation managers confronted with limited irrigation water should consider making the most efficient use of water by their crops. For seed crops, this means cutting

back on early-season irrigations and ensuring minimum stress conditions between seed development and maturity. For root, tuber and forage crops, irrigation managers should minimize the number of early-season irrigations and eliminate late-season irrigations.

The publication, "Grain yields related to stored soil water and growing season rainfall" published in 1990 as MSU Ag Exp Station Special Report 35 by Paul Brown and Gregg Carlson is out of print but may be available at a library. The following publications can be order from local county Extension offices or from Extension Publications at MSU. Phone 406-994-3273 or email acxtb@montana.edu.

"Irrigation Water Management - When and how much to irrigate" 1989. MSU Montguide MT8901, by USDA and MSU Extension - Request Montguide 8901.

"Power consumption for irrigation" 1991. MSU Montguide MT9122(AG), by Gerald Westesen, James Bauder, and John Dalton - Request Montguide 9122(AG).

"Using evaporation tubs to schedule irrigations" 1983. MSU Montguide MT8343, by James Bauder, Larry King, and Gerald Westesen - Request Mongtuide 8343.

"Yard and garden water management" 1989. MSU Montguide MT8915, by Larry Hoffman, Jeff Jacobsen, Kevin Laughlin, Mike Vogel, and Terry Wolfe - Request Mongtuide 8915.

"Estimating small grains yield potential from stored rainfall probabilities" 1983, MSU Montguide MT8325, by James Bauder et el. - Request Montguide 8325.

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